Finite-Difference Time-Domain Simulation of Photovoltaic Structures using a Graphical User Interface for MEEP

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There is a large and growing need for accurate full-wave optical simulations of complex systems such as photovoltaic (PV) cells, particularly at the nanoscale. A finite-difference time-domain tool known as MEEP offers this capability in principle, through C++ libraries and the Scheme programming language. For expert users, this approach has been quite successful, but there is also great interest from new and less frequent users in starting to use MEEP. In order to facilitate this process, we have developed a graphical user interface (GUI) for MEEP, geared toward simulation of 2D and 3D PV cell geometries, freely available through a Java-based web browser on nanoHUB.org. A software toolkit called Rappture was used to develop our GUI. The tool collects input from the Rappture interface, and uses it to create a Scheme control file to run MEEP on the back end as before. It outputs images of the PV cell structure being simulated; graphs of the transmission, reflection, and absorption; as well as an animation of the fields propagating through the PV cell. This tool was subsequently used to examine and optimize the properties of surface texturing for different classes of PV cells. In conclusion, our new, fully interactive tool saves time and effort for researchers investigating nanophotonic structures, and is freely available to the general public.